

**APPLICATION**  
**FOR**  
**UNITED STATES PATENT**

TO ALL WHOM IT MAY CONCERN:

**Be it known that We,**

Louis MAGILL

Bob SEMONES

Tom HALLER

Mario JIMENEZ

Kevin MUELLER

Barry SCADDEN

and

Steven C. RUBINOW

have invented a

**System and Method for**  
**Interactive Electronic Open Order Book**  
**for Securities Transactions**  
of which the following is a description.

# **SYSTEM AND METHOD FOR INTERACTIVE ELECTRONIC OPEN ORDER BOOK FOR SECURITIES TRANSACTIONS**

**This is a Continuation Application based on U.S. Patent Application No. 09/609,028 filed June 30, 2000, now abandoned.**

This application claims the benefit of Provisional Application 60/141,859, filed July 1, 1999, and Provisional Application 60/155,489, filed September 23, 1999, the entire disclosures of which are incorporated herein by reference. This application is related to U.S. Application entitled "Method and Apparatus for Processing Securities Transactions" by inventors Louis Magill and Bob Semones filed June 30, 2000 and U.S. Patent Application entitled "System and Method for Match and Range Securities Transaction Orders" by inventors Louis Magill and Bob Semones filed June 30, 2000, which are incorporated herein by reference.

## **TECHNICAL FIELD**

The present invention relates to a securities trading method and system, and in particular to an improved computer automated securities trading system.

## **BACKGROUND OF THE INVENTION**

The buying, selling, or trading of securities such as stocks, options, futures, commodities is conducted through a broker or brokerage firm. The brokers or brokerage firms either deal directly with a security exchange, such as the National Association of Security Dealers Automated Quotation (NASDAQ) system, or directly with other brokers or brokerage firms to buy, sell or trade securities.

Individual securities traders must use the services of either a broker or brokerage firm in order to buy, sell or trade their securities. An individual will communicate to his broker or brokerage firm the security they are interested in and the specifics of the buy or sell order. The use of computers and the internet to communicate with one's broker or brokerage firm is well-known.

## SUMMARY OF INVENTION

It is an object of the invention to provide an improved securities trading system.

5        A further object of the present invention is to provide a securities trading system which includes an Interactive Open Order Book capable of allowing Subscribers via the Internet to aggregate, manipulate, display and interact with the buy and sell order data.

10       A further object of the present invention is to provide a securities trading system which can trade securities of a given exchange both inside and outside of the traditional trading hours of the given exchange.

15       In a preferred embodiment, the invention provides an automated securities trading system for displaying an interactive open order book and for matching buyer bids to seller offers which comprises a means for generating a web page which displays an open order book to a securities buyer or securities seller, the open order book comprises data describing a plurality of current bid prices and a plurality of current ask prices of a specified security and an identification of said security.

20

## BRIEF DESCRIPTION OF DRAWINGS

25       FIG. 1 is a block diagram of an exemplary hardware environment of the preferred embodiment of the present invention;

FIG. 2 is another block diagram of an exemplary hardware environment of the preferred embodiment of the present invention;

FIG. 3 depicts a screen illustrating the Interactive Order Book;

FIG. 4 depicts a screen illustration the Order Book;

FIG. 5 depicts a screen where a user can preview company and securities related data;

FIG. 6 depicts a screen where a user can obtain summary and historical pricing  
5 data of securities;

FIG. 7 depicts a screen where a user can view financial information extracted from SEC filings;

FIG. 8 depicts a screen where a user can view a market summary for all listed companies.

10

## DETAILED DESCRIPTION

The present invention relates to a system which includes novel software that  
15 operates in combination with general purpose computer hardware to provide an electronic auction, matching system or trading system for securities and other goods and services. With regard to the auction, matching or trading of securities, the invention further provides an electronic communications network (ECN), alternative trading system (ATS), or electronic exchange. The system of the invention provides members with the  
20 capability of performing auction, matching and trading transactions via the Internet and other available communication mediums. Trading, auction or matching relates to the facilitation of connecting buyers and sellers for the purpose of displaying information and consummating transactions. The term "Subscribers" as used herein includes any type of trading participant in the system, and the term or "the System" as used herein means the  
25 system of the invention.

The system configuration, in a preferred embodiment, is discussed with reference to Figures 1 and 2. The securities trading system 100 links a Subscriber's desktop unit 105 with the system servers 162, 164 which process securities trading. The Subscriber's

desktop unit 105 can be connected to a Subscriber's server 110 or to a front end processor 112. The Subscriber's server 110 would preferably use an Application Program Interface (API) which is a specific communication language and system for the present invention. However, the Subscriber's desktop system 105 may also use a front end processor 112  
5 utilizing a FIX system for connecting through the Internet.

The Subscriber's server 110 or front end processor 112 are then connected to a Subscriber router 115. Based upon the system and communications available the Subscriber router 115 will route the communication from the Subscriber Desktop system  
10 105 to any of three possible paths.

First, if the Subscriber is using an Internet or WEB connection the Subscriber router 115 will direct the communication along the WEB connection 117 to the WEB or Internet which is depicted as the WWW cloud 120. The WWW cloud 120 or Internet  
15 connection is then routed by WEB router 122 through a Firewall 124 to the two securities trading servers 162, 164. The securities trading servers 162, 164 are configured to communicate using the API or FIX system. The securities trading servers 162, 164 are also connected to a system administration network 170. Communication from the securities trading servers 162, 164 back to the Subscriber travels along the same path.

20  
Second, provided the Subscriber has a leased line or direct connection the Subscriber router 115 will direct communication through the leased line connection 118 into the attached FRAME cloud 130 and ATM cloud 140. The FRAME cloud 130 and ATM cloud 140 convert the communications into an asynchronous transfer mode which  
25 structures the exchange into tiny units of information cells. The information cells are then routed by the ATM router 142 to the securities trading servers 162, 164 for processing securities trades. Communication from the securities trading servers 162, 164 back to the Subscriber travels along the same path.

The third communication path which utilizes a phone dial up system is considered more of a backup in the event that the Subscriber can not connect using either their WEB connection 117 or leased line connection 118. In the event that a connection through the WEB connection 117 or leased line connection 118 cannot be made the Subscriber

5 Router 115 will route the communication over a dial backup communication line 119 to a PSTN cloud 150. The PSTN cloud 150 communicates with a digital modem 152 which directs the information to the securities trading servers 162, 164 for processing securities trades. Communication from the securities trading servers 162, 164 back to the Subscriber travels along the same path.

10

The WEB connection 117, the Leased Line connection 118 and the phone backup connection 119 can each be employed individually or in any combination to provide redundant and backup systems. In a preferred embodiment, a subscriber would have all three systems employed.

15

As seen in Figure 2, a client or Subscriber may have their own Local Area Network (LAN) 101 so that multiple users can utilize the system. The Client LAN 101 is connected to the Client/Subscriber router 115 for routing the information through the WEB connection 117, the Leased Line connection 118, or the phone dial backup

20 connection 119. Evident from Figure 2 is that the WEB connection 117 is connected to the Internet 120 which is connected via Internet routers 122 and multiple Firewalls 124 to the trading system servers 162, 164. The Leased Line connection 118 connects to a FRAME cloud 130 which can connect to the trading system servers 162, 164 in two ways. The FRAME cloud 130 is connected to a market router 126, such as the

25 NASDAQ, which is connected through a Firewall 124 to the trading system servers 162, 164. The FRAME cloud 130 could also be connected to an ATM cloud 140 which converts the information into information cells. An ATM router 140 connects the ATM cloud to the trading system servers 162, 164 after passing through a Firewall 124. The phone dial backup connection 119 connects through the PSTN to a dial backup

router/modem 152 which connects the PSTN cloud to the trading system servers 162, 164 after passing through a Firewall 124. Also shown in Figure 2, is a second Subscriber 103 connected to the system 100 via the WEB or Internet 120.

5           The trading system servers 162, 164 are configured to allow one server to be the primary server while the other server is used as a backup server. However, the system could be designed to allow both servers to be used concurrently. The trading system servers 162, 164 share a combined data storage 166 and are connected to the system administration network 170.

10

          The system administration network 170 is comprised of an internal router 172, Local Area Network 173, a Firewall 174, an application server 176, an audit server 180, and a data bank 182. Personnel used to administer the system 100 can be connected to one another and the system 100 via a Local Area Network 173 which is connected to the  
15   Trading System Servers 162, 164 through an internal router 172 and Firewall 174. The Application server 176 is used to run system application and monitoring systems which insure the integrity and functionality of the system 100. The Audit server 180 and the data bank 182 are used in conjunction to both store back-up data and to survey, obtain and provide securities trading market information.

20

          As will be described with reference to Figures 3-8, Subscribers interact with the trading servers 162, 164 depicted in Figures 1 and 2, through various interactive screens displayed on their desktop system 105.

25           Figure 3 depicts a screen containing an Interactive Order Book 300 which may contain the company name 302, the company symbol 304, a company symbol command search button 306, an order status bar 308, a Match Order Price box 310, buy orders 320, and sell orders 340. The buy orders 320 may contain information relating to the order number 322, the number of shares 324 and the price 326. The sell orders 340 may

contain information relating to the order number 342, the number of shares 344 and the price 346. The Interactive Order Book 300 may also contain an order window 350 which allows a Subscriber to input a buy or sell order. The order window 350 may contain information relating to price 352, type of order 354, volume 356, show volume  
5 358, time 360, and a route 362. The Subscriber can then click on the Buy button 364, the sell button 365, the cancel all button 366 or the cancel all orders button 367. The Subscriber will also have the option to make the order a short exempt order 368 or an In/Out order 369.

10 The Interactive Order Book 300 may also contain a last executions window 370 for a specified company and a system transactions window 380. The system transactions window 380 contains real time information for new orders and real time information for executed orders. The system wide new or pending orders are displayed in a pending orders window 381 and the executed orders are displayed in an execution status window  
15 391. In addition, the Subscriber will have the ability to configure the Interactive Order Book 300 to show all of the features described above or to modify the configuration to show only the features desired.

By utilizing the Interactive Order Book 300 a Subscriber can view open buy  
20 orders 320, open sell orders 340, the Match Order Price 310, system wide pending orders 381 and the system wide execution status 391 while being able to interact with the system to place or execute orders. The Interactive Order Book 300 serves as a single point of price discovery for securities traded over the system 100 of the present invention. The Interactive Order Book 300 allows the Subscriber to view the most competitively priced,  
25 outstanding and unexecuted orders and is an investment tool for price discovery and order tracking. The orders are prioritized on the order book according to price and time.

Figure 4 depicts a screen which contains a non-interactive order book 301. The non-interactive order book 301 contains the same open order information as the

interactive order book 300 but does not allow include the order window 350, match order price box 310, last executions window 370, or the systems transaction window 380. The non-interactive order book 301 may contain the company name 302, the company symbol 304, a company symbol command search button 306, Last Match price 309, a Last Match time 311, buy orders 320, and sell orders 340. The buy orders 320 may contain information relating to the order number 322, the number of shares 324 and the price 326. The sell orders 340 may contain information relating to the order number 342, the number of shares 344, and the price 346.

10           Figure 5 depicts a screen which contains a company summary profile 400. The company summary profile 400 may contain the company name 102, a company profile 410, a company summary 420, stock quotes 430, and company news 450. The company profile 410 may contain a profile of the company including the type of business or service they provide. The company summary 420 may contain information relating to the  
15   company address, company web site, and the officers of the company. The stock quotes 430 contains stock pricing information relating to that company and may include the last system executed transaction 431, the last system bid 432, the last system ask 433, the national open price 434, the national high 435, the national low 436, the exchange the stock is traded on 437, the national last executed transaction 438, the national last bid  
20   439, the national last ask 440, the national volume 441, the national change 442, the 52 week high 443, and the 52 week low 444. The company news 450 may contain links to news stories relating to that company. In addition, the Subscriber will be able to view additional pages through use of the profile summary link 460, the Charting link 465, the SEC filings link 470, or the Financials link 475.

25

Figure 6 depicts a screen which contains charting and pricing information 500. Once again the charting and pricing information 500 may contain a company summary 420, stock quotes 430, the profile summary link 460, the Charting link 465, the SEC filings link 470, and the Financials link 475 as described above. Further, the charting and

pricing information 500 will contain a charting window 510. The charting window 510 will be able to display charts based with varying time increments by selecting a time increment such as the current trading day, the last 3 months, 6 months, 9 months, 12 months, 24 months, 48 months, 72 months, or 96 months by clicking on the preferred  
5 time increment on the time selection bar 520. Further, based upon the time increment chosen the Subscriber can select to chart the daily price changes, the closing price or the share volume.

Figure 7 depicts a screen which contains company financial information 600  
10 which is extracted from Securities Exchange Commission (SEC) filings. Once again the charting and pricing information 500 may contain stock quotes 430, the profile summary link 460, the Charting link 465, the SEC filings link 470, and the Financials link 475 as described above. The company financial information 600 contains a Financial window 610 which may contain information relating to revenues 612, income 614, EBITDA  
15 (earnings before interest, tax, depreciation and amortization) 616, net earnings 618, earnings per share 620, earnings per share (diluted) 622, current assets 624, long term assets 626, and total assets 628.

Figure 8 depicts a Market Summary 700 screen a Subscriber may use as a unique  
20 tool to serve as a single point of information for trading activity on the system 100 described in Figures 1 and 2. The Market Summary 700 will contain links to the Interactive Order Book and to Company summary pages. As seen in Figure 7, the Subscriber can use the Market Summary link 702, the Order Book link 704 or click on the Research bar 710 for researching companies. Further, the Subscribers will be able to  
25 customize the Market Summary 700 to display Subscriber dictated information. The Market Summary 700 may contain information relating to the company name 720, the ticker or stock symbol 730, the % change 740, and tick price indicator 745, the tick (price or change since last transaction) 750, the exchange 755, the bid price 760, the ask price

765, the last price 770 and national data 780 such as the national last price 785 and the national volume 790.

5       The system of invention is designed to support a number of protocols governing communications with said system. The preferred embodiment of such protocols is a proprietary Application Programming Interface (API). A secondary protocol relating to securities trading is the Financial Information Exchange (FIX) protocol.

10       A proprietary Application Programming Interface (API) is the preferred embodiment of communications with the system. The API facilitates the integration of the systems' Graphical User Interface (GUI) or external systems, with the system of invention. The API is comprised of two parts. 1) Message definition between the System and Subscribers and 2) a software library comprised of calls a Subscriber will incorporate into their system. The API communicates with TCP/IP and can be used over a dedicated  
15       circuit or the public Internet. The API employs a Secure Socket Layer (SSL) for privacy. The SSL layer enables all communication between the Subscriber and system to be encrypted with 128-bit encryption. The TCP/IP and SSL are internal to the Library and Subscribers do not need an intimate knowledge of the Library to use the API. Messages are passed to the API as C structures. The API will place a proper header and footer for  
20       transport between the Subscriber and the System.

The API library is designed for simplicity is comprised of four (4) function calls:

25       OpenConnection  
      CloseConnection  
      SendMessage  
      RecvMessage

#### **Open Connection**

30       Open connection establishes a Secure Socket Layer connection with the System over a TCP IP Link. OpenConnection will return success when a connection is established. If,

a connection cannot be established, the function will return a non-zero value if an error occurs.

### **CloseConnection**

- 5    **CloseConnection** will close the TCP/IP link to the System. The function will return a non-zero value if an error occurs

### **SendMessage**

- SendMessage operates in blocking mode. The function will not return until there is error  
10    in the connection or the message is delivered. This function will take the given message and add a proper header and footer to the message. It then encrypts the message with 128-bit encryption before sending over the SSL layer and then over the TCP IP link.

### 15    **RecvMessage**

- RecvMessage operates in blocking mode. The function will not return until there is error in the connection or a full message is received. This function will only return the message sent from the internal system. It is the user responsibility to have a buffer available to handle all message size to could be received. Before returning the message  
20    to the Subscriber, the message is decrypted and the header and footer are strip off.

- Subscribers may choose to conform to the Financial Information eXchange (FIX) protocol. The FIX protocol is a messaging standard developed specifically for real-time  
25    electronic exchange of securities transactions. FIX is a public-domain specification owned and maintained by the FIX Organization.

The system of invention is designed to accept messages from either its accompanying Graphical User Interface (GUI) or external systems (according to a

protocol). The GUI in its preferred embodiment is a browser based interface . The GUI allows Subscribers to access the system, view system information, submit messages for processing by the system, and request information on messages being processed by the system. Each Subscriber may have multiple users, each with a unique IDs and passwords  
5 required to access the system. The GUI may also take the form of a software interface or other electronic means.

The GUI in its preferred embodiment includes the following functions designed to simplify and enhance User interaction.

10

The color coding of buy and sell orders on the book to aid in the intuitive identification of the orders. This includes coloring of orders that are better than the nationally disseminated best buy or ask sell prices. The preferred embodiment of the color coding schema is:

15

<b>Green</b>	System has the same or better price than the national best
<b>Red</b>	The national best is better than the System.
<b>Black</b>	National Market is closed

20 The GUI allows individual users to customize their color scheme and includes the option to specify a color (which only that user sees) to designate their outstanding orders on the system.

25 Users of the GUI have the ability to “hit the book”, simply by double clicking their mouse on an order. When an order is hit, a contra-side order is sent to the system as an immediate or cancel (IOC) limit order at the price listed on order to be “hit”.

The GUI includes a “cancel all orders for a security” function. The *Cancel all* function allows the GUI user to cancel their outstanding orders for the current Order

Book's security. By clicking this button a special order type of "cancel orders" will be sent to the system and all of the user traders outstanding orders (or portions thereof) for this security will be canceled.

5           The GUI includes a "cancel all orders function." The *Cancel all Orders* function allows the user to cancel all of their outstanding orders for the current Order Book's security. By clicking this button a special order type of "cancel all orders" will be sent to the system and all outstanding orders (or portions thereof) for this security will be canceled.

10

          The system of the invention in its preferred embodiment further provides an interactive order book system for aggregating, manipulating, displaying and interacting with order data. In this respect, the invention provides a means on the public Internet for investors to view qualifying buy and sell orders in an electronic format. An alternative  
15       version of the Interactive order book may be offered to system Subscribers over the GUI. This version allows Subscribers to interact with the book, as described above, with a single action (such as a right click of the mouse).

          In addition to conventional types of securities trading orders (e.g., market orders,  
20       limit orders, stop orders, etc.), the system of the invention in its preferred embodiment supports "match" orders and "range" orders. These novel order types are described below.

          The match order is a novel type of order that augments existing methodologies of  
25       generating liquidity in otherwise illiquid markets. The system of the invention can dynamically search out the National Best Bid and Offer (NBBO) and continuously determine the decimalized mid-point of the NBBO. This can be accomplished mathematically by converting the NBBO numbers to decimalized format, if necessary; then adding the two numbers and dividing by two (2), the result being the arithmetic

median. The result can then be truncated to two decimal places. The mid-point can be calculated in other manners as well, such as by calculating the arithmetic mean. The resulting number can be displayed in the Open Limit Order Book for each security registered on the system as the "Match" price at that moment in time. It is a floating  
5 number and will change in direct relationship to changes in NBBO or internal best bid or offer.

The business rules by which the system preferably makes use of the mid-point number are also unique. The "Match" Order preferably includes the variables:

10

Buy or Sell indication.

Number of shares to be bought or sold.

Designation of the order as a "Match" type of order.

An optional "Limit" price of the calculated "Match" price above or below which  
15 the order becomes invalid

An investor that wishes to enter a "Match" Order can click the button on the order form containing such designation. The word "Match" or "MCH" or a systematically generated price then appears in the Price window. In addition, the investor preferably  
20 must also define the "Limit" Price that may accompany the order so that the investor specifically states a price above which he will not buy or below which he will not sell.

Once a "Match" Order is entered into the system, it is placed at the top or ranked by the dynamic price within the "Limit Order Book" of the Trading System in accordance  
25 with time priority rules with other "Match" Orders on the same side of the market. A "Match" Order can be executed against another "Match" Order regardless of size, thereby allowing for partial "fills." A "Match" Order can also be executed against a "Market" Order entered subsequent to the posting of a corresponding "Match" Order or a "Limit" order at the dynamically generated "Match" price.

Match orders preferably execute against a number of other order types. Match orders may execute against a limit order at or better than the dynamically calculated match price. In addition, match orders may execute against incoming market orders, providing price improvement for the market order.

The "Range" Order is a further novel type of order which may be provided by the system of the invention. With conventional order entry in the securities markets, the investor can only specify the maximum number of shares he is willing to sell. He has never been able to determine the minimum number of shares with the exception of two historical order types, "Fill or Kill" and "All or None," which made the minimum number of shares to be purchased the same as the maximum number of shares. Using the "Range" Order of the invention, an investor effectively is able to communicate, as part of his order, the fact that he is willing to sell shares in minimum lot sizes up to a maximum number of shares. This order can receive partial "fills" as long as each partial "fill" or execution is in accordance with the minimum number of shares specified in the order. Therefore, a "Range" Order entered for 400 – 1000 shares could be "filled" in the following combinations:

- One order for 1000 shares
- Two orders for 500 shares
- One order for 400 shares and one order for 600 shares

It should be noted that, in the preferred embodiment, a "Range" Order that receives a partial "fill" or execution and which still has sufficient shares remaining that equal or exceed that minimum size in the order will remain open for the designated duration, be it a "Day" Order or "GTC" (Good 'Til Canceled).

In the event that a "Range" Order receives a partial "fill" whereby the remaining number of shares is less than the minimum number of shares stated in the order, the order is preferably considered to be complete and the remaining shares are canceled. The Subscriber in this case will receive notification that he is "filled" on "X" number of  
5 shares and "canceled" on the remaining "X" number of shares.

Using the above example of a "Range" Order of 400 - 1000 shares, the following single executions may have the following results:

10         700 shares "filled." Report to investor: "700 shares filled. Remaining 300 shares canceled. Order complete."

800 shares "filled." Report to investor: "800 shares filled. Remaining 200 shares canceled. Order complete." This report would also be issued on the second order in the event that the 800 shares was "filled" by two 400 share executions.

15         900 shares "filled." Report to investor: "900 shares filled. Remaining 100 shares canceled. Order complete." This report would also be issued on the second order in the event that the 900 shares was "filled" by a 400 share execution plus a 500 share execution.

20         The system of invention is preferably designed to trade inside and outside of traditional trading hours, thereby providing Subscribers greater access to both a transaction network and pools of liquidity. The system is designed to maintain a number of "states" during the day to reflect the different environments in which it will be trading. Each state has a series of associated business rules (such as which order types it will  
25 process), each designed to preserve a fair and orderly marketplace for its Subscribers, cognizant of environmental conditions.

One of the novel aspects of the system is the means through which its orders can interact and the way such interaction provides price improvement opportunities for its Subscribers. All orders that are entered into the system can execute against one another.

5

First level examples of such interaction are:

	<i>Buy Side</i>	<i>Sell Side</i>
	Limit	Limit
10	Limit	Match
	Limit	Market
	Limit	Range
	Market	Limit
	Market	Market
15	Market	Match
	Market	Range
	Match	Range
	Match	Match
	Match	Limit
20	Match	Market
	Range	Match
	Range	Limit
	Range	Market
	Range	Range

25

It should be noted that a single order may execute against all possible combinations of orders on the contra side. This relationship creates an endless possibility of combinations that can be created as the contra side for an incoming order.

The system of invention in its preferred embodiment employs an order-matching algorithm designed to seek the best mutual matching price. This algorithm examines the prices designated within each order (for match orders this is the dynamically calculated match price, for market orders this is equivalent to the nationally disseminated best price) and then selects the mid-point of the two prices (the preferred embodiment of which is expressed and matched to four decimal places). In the event that the mid-point is not between the nationally disseminated best bid and ask prices (the NBBO), the system will look for a price at which it can match at a price equal to or better than the NBBO.

The invention preferably employs a trading system database (TSD) for use in its primary processing system (trading system). The trading system also interacts with a separate database instance that will serve as the central data repository (CDR). The CDR houses all historical information regarding trading instruments, Subscribers, and trading activity. The CDR also serves as the primary administrative database, in which all administrative changes (new trading instruments, new Subscribers, name changes, etc.) are made. The trading system interacts with the CDR at defined intervals to update its tables of trading instruments (such as securities) and qualified Subscribers. The trading system also interacts with the CDR at defined intervals to upload all trading information from the TSD into the CDR for storage and processing.

20

The TSD is described in detail. The TSD will be comprised of a number of tables and will, at a minimum, encompass the following four areas:

Security (or product or service or trading instrument) Information (db\_stock.h) - maintaining information specific to a security (or trading instrument or product or service) and the unique trading requirements and properties thereof;

Subscriber Information (db\_firm.h) - maintaining information specific to a Subscriber and the unique trading requirements thereof;

Order Information (db\_order.h) - maintaining information specific to an Order and the processing thereof;

- 5 Trade Information (db\_deal.h) - - maintaining information specific to a match (execution) and the unique properties thereof.

Examples of each table are provided below:

## 10 DB\_STOCK.H

```

long  INextRec;          /* Next available record */
short iIndex[27];        /* Index into table for symbol */
short iMaxRouteQue;      /* Max route queue depth */
15 short iFlushTimer;     /* Gbl flush timer, (sec) */
short iBookTimer;        /* Book update msg timer, (sec) */
                          /* Trading times */
short iPreopenTime;      /* Time for preopen (hhmm) */
short iOpenTime;         /* Time to open market (hhmm) */
20 short iAfterHoursTime; /* Time for after hours (hhmm) */
short iCloseTime;        /* Time to close market (hhmm) */
char  cMktStatus;        /* Market status */
                          /* O-Open, P-Preopen, H-Halt */
                          /* B-BeginOpen, C-Closed */
25 char  cExchange;       /* Exchange code */
                          /* G=GlobeNet */
char  cFlush;            /* DB flushed Y/N */
char  cRoute;            /* Routing on Y/N */
char  cRouteExchange;    /* Routing exchange code */
30 } *DB_SEC_HEADER;
typedef struct sec_rec
{
long  IFirstBid;          /* First buy order record */
long  ILastBid;           /* Last buy order record */
35 long  IFirstAsk;        /* First sell order record */
long  ILastAsk;           /* Last sell order record */
long  IBidPx;            /* Exchange bid price */
long  IBidSize;          /* Exchange bid size */

```

	long	lAskPx;	/* Exchange ask price */	
	long	lAskSize;	/* Exchange ask size	*/
	long	lNBidPx;	/* National bid price	*/
	long	lNBidSize;	/* National bid size	*/
5	long	lNAskPx;	/* National bid price	*/
	long	lNAskSize;	/* National ask size	*/
	long	lHigh;	/* High price today	*/
	long	lLow;	/* Low price today	*/
	long	lVolume;	/* Volume traded today	*/
10	long	lOpen;	/* Open/Proj open price */	
	long	lPriorHigh;	/* Prior day high price	*/
	long	lPriorLow;	/* Prior day low price	*/
	long	lPriorVolume;	/* Prior day volume traded	*/
	long	lPriorOpen;	/* Prior day open price	*/
15	long	lPriorClose;	/* Prior day close price	*/
	long	lAverageVol;	/* Average daily volume	*/
	long	lLastPx;	/* Last sale price	*/
	long	lLastShares;	/* Last sale size	*/
	long	lLastTime;	/* Last sale date/time	*/
20	long	lNLastPx;	/* External Last price	*/
	long	lNLastShares;	/* External Last size	*/
	long	lNLastTime;	/* External Last date/time	*/
	long	lMaxOrdSize;	/* Max order size	*/
	long	lMinOrdSize;	/* Min order size	*/
25	long	lHaltTime;	/* Time of halt	*/
	short	iSpread;	/* Min price spread	*/
	char	cBidExchange;	/* Exchange of best bid	*/
	char	cAskExchange;	/* Exchange of best ask	*/
	char	cMktStatus;	/* Stock status	*/
30			/* O-Open, C-Close, H-Halt	*/
			/* S-Suspended, P-Preopen	*/
	char	cNationlOpen;	/* External mkt open	*/
			/* C-Closed, O-Open	*/
			/* A-After Hours	*/
35	char	cTick;	/* Tick +, -, "	*/
	char	cPrevTick;	/* Previous Tick +, -, "	*/
	char	cNTick;	/* External Tick +, -, "**/	
	char	cPrevNTick;	/* Previous External Tick	*/
	char	cListing;	/* Listing status	*/
40			/* G=GlobeNet	*/
			/* A=Amex	*/
			/* M=Chicago	*/
			/* N=NYSE	*/
			/* P=Pacific	*/

```

/* Q=Nasdaq NM */
/* S=Nasdaq SC */
/* U=OTCBB (US) */
/* V=OTCBB (foreign) */
5 char cBuySideHit; /* Hit between last update */
char cSelSideHit; /* Hit between last update */
char sSymbol[DB_SYMBOL_LEN]; /* Stock symbol */
char sCusip[DB_CUSIP_LEN]; /* Stock CUSIP */
char sFill[1]; /* Fill to longword boundry */
10

DB_FIRM.H

long lCommLink; /* CTCI comm link number */
long lFirmSeq; /* Firm seq number */
15 long lFirmLink; /* Firm order link head pointer */
char sClientID[DB_CLIENTID_LEN]; /* FIX-109 Firm ID */
char sSymbol[DB_SYMBOL_LEN]; /* FIX-55 Firm's stock symbol */
char cStatus; /* Firm status */
20 /* A-Active, S-Suspend */
char cOrderRouting; /* Order routing Y/H/R/C */
char cAfterHours; /* After hours trading Y/N */
char cMktMaker; /* M-MarketMaker, B-BD */
char cRule80A; /* FIX-47 */
25 char cQSR; /* Y/N */
char cAGU; /* */
***** Comm Stuff
char sLineId[DB_LINEID_LEN]; /* CTCI line id */
char sCommPort[DB_COMMPORT_LEN]; /* CTCI comm port name */
30 char sCommPswd[DB_COMMPSWD_LEN]; /* CTCI comm link password */
char cCommProtocol; /* CTCI protocol type */
/* T - TCP/IP */
/* B - Bisync */
/* D - Decnet */
35 /* S - SNA */
/* X - X.25 */
/* M - MRDP */
/* F - Siac FMP */
char cHoldIntnl; /* FIX-9140 1=Hold */
40 sTargetTrader[10] /* sCompID[10] */

```

# DB\_ORDER.H

```

long  lNextRec;           /* Next available record      */
long  lDumpTime;          /* Time of last dump to disk */
5 long  lRejects;          /* Orders rejected           */
long  lKickBack;          /* Orders returned, better NBBO */
long  lRoutes;            /* Orders routed             */
long  lQuoteCount;        /* External quotes counter   */
long  lLastCount;         /* External last sale count   */
10 long  lGblDump;         /* Global dump counter       */
short iLastArchive;       /* Time archive was run (hhmm) */
char  cLastDump;          /* File ext for glb backup file */
} *DB_ORDER_HEADER;typedef struct order_rec
{
15 long  lFwdSecLink;      /* Forward security link (rank) */
long  lBkSecLink;         /* Back sec link pointer (rank) */
long  lFirmLink;          /* Firm link                   */
long  lOrderQty;          /* FIX-38 Initial volume      */
long  lLeavesQty;         /* FIX-151 Volume remaining    */
20 long  lPrice;           /* FIX-44 Scaled price        */
long  lStopPx;            /* FIX-99 Stop Price          */
long  lTime;              /* Entry date/time            */
long  lCxlTime;           /* Order Cancel date/time     */
short iSec;               /* Security record number     */
25 short iFirm;            /* Firm ptr                   */
char  cRule80A;           /* FIX-47                     */
char  cOrdStatus;         /* FIX-39 Order status        */
char  cOrdType;           /* FIX-40 Order type          */
char  cSide;              /* FIX-54 Side                */
30 char  cTimeInForce;     /* FIX-59                     */
char  cExecInst;          /* FIX-18 Conditions          */
char  cExchange;          /* Routing Exchange           */
char  cHoldIntrnl;        /* FIX-9140 1=Hold Internal   */
char  cExtendedHours;     /* FIX-9133                   */
35 char  sClOrdID[DB_CLORDID_LEN]; /* FIX-11 Firm order ID      */
char  sFill[2];           /* Keep it on longword boundry */

```

# DB\_DEAL.H

40

```

long  lNextRec;           /* Next free record           */
long  lActAck;            /* # of Act messages sent     */

```

```

long   lActAsOfAck; /* # of Act as of msgs sent      */
long   lVolume;      /* Volume traded today      */
} *DB_DEAL_HEADER;
typedef struct deal_rec
5  {
    long   lBOrd;      /* Order rec pointer (buy)   */
    long   lSOrd;      /* Order rec pointer (sell)  */
    long   lLastPx;    /* FIX-31 Price              */
    long   lLastShares; /* FLX-32 Volume             */
10  long   lTransactTime; /* FIX-60 Date/Time of deal */
    char   cExchange;  /* Trading Exchange         */
                        /* G=GlobeNet               */
                        /* A=Amex                   */
                        /* M=Chicago                */
15  long   lTransactTime; /* N=NYSE                   */
                        /* P=Pacific                 */
                        /* Q=Nasdaq NM              */
                        /* S=Nasdaq SC              */
                        /* U=OTCBB (US)             */
20  long   lTransactTime; /* V=OTCBB (foreign)        */
    char   cActReported; /* Reported to ACT Y/N      */
    char   cCleared;    /* Cleared Y/N              */
    char   sFill[1];    /* Filler                    */
25

```

Order/Message validation in accordance with a preferred embodiment of the invention will now be discussed in detail. All incoming messages (and elements thereof)

30 are subject to validation according to defined business logic, as it may change from time to time. Primary validation occurs on the application (trading system) level, although validation may also occur on the protocol level. A hierarchical process governs system validation. Messages that do not pass all such validation will be rejected and a rejection message returned to the appropriate Subscriber. In its preferred environment that

35 hierarchy is:

System Status – Is the system accepting (for processing) the message type during its current state.

Subscriber Validation – Is the Subscriber identified in the message eligible to trade on the System.

5        Trading Instrument ID (Symbol) – Is the product or service specified in the message eligible for trading on the system.

Security State – Is the security specified in the message currently in a state for which this message can be processed.

10

Order Type – Is the order type (if applicable by message type) specified in the message eligible for processing during this System state.

15

Volume – Does the volume specified in the message (if applicable by message type) meet the minimum standards set for processing by the System.

Price – Is a price specified in the message (if applicable by message type and order type) and if so does the price meet any specified limitations thereon.

20

Side – Does the message/order have a specified side (such as buy or sell, if applicable by message type) and if so are there any special restrictions places around the processing of such side.

25

Size – Does the message/order have a specified size limitation (such as a \$ value, calculated from price x volume, if applicable by message type and side) that it must meet for processing by the System.

Time in Force (TIF) – Is the time in time in force value (if applicable by message type and system state, security state) associated with the order valid for processing by the system given its current state.

5           Extended Hours – Is the order marked for trading outside of traditional trading hours, and if so is such order eligible for processing therein.

Order/Message processing in accordance with a preferred embodiment of the invention will now be discussed in detail. Order messages are processed by the system in  
10   the sequence that they are received. The system governs application level validation and all aspects of order interaction, display and matching.

Orders that comply with all application-level validations are assigned a unique sequence number. The sequence number will be provided to the Subscriber and used for  
15   tracking purposes. Validated orders are queued for processing and are available for matching. If an order is capable of execution (an acceptable contra side-party is found), a match will occur. If an order is not capable of matching, it is displayed on the Order Book or processed via Subscriber specific order instructions. Orders are matched according to a price and time priority.

20   The system in its preferred embodiment operates as a continuous matching system for orders entered therein. A matching cycle is precipitated, for a security, upon the following:

25           Receipt of a New Order  
              Change in Order State  
              Change in the NBBO or external price

Upon the occurrence of an event precipitating a matching cycle the system will:

Perform an evaluation as to where the best execution of an order can be found (price and size):

- If internal go to step 2, or
- If external and the order is executable (price and size), follow
- Subscriber specific instructions in the hold internal flag,
- performing one of the following:
  - Hold internal for processing, or
  - Route the order for manual processing, or
  - Respond to other instructions may be
  - incorporated, or
  - Return the order to the Subscriber
- Employ an algorithm to select countervailing parties for matching:
  - If contra parties found, go to step 3, or
  - If no parties can be found, display and rank in the book (End);
- Record (update) matched trades in the database; and
- Remove orders (from book) if fully executed, update size if partial fill; and
- Deliver execution message to appropriate Subscriber(s); and
- Deliver message for trade reporting, as appropriate; and
- Repeat until no further transactions can be processed.

Order routing/return will now be described in detail. The system constantly monitors the best internal and published external prices available for its trading securities, product or service. In the event that the external primary market is open for trading, a better price (execution) is available externally, and the order is fully or partially executable (price and size), the system will take action to facilitate execution at the better price, as instructed by the Subscriber. It will either:

- Hold internal for processing, or
- Route the order for manual processing, or

Respond to other instructions as may be incorporated, or  
Return the order to the Subscriber

Trading on the system is preferably accomplished in decimals, the preferred  
5 embodiment being four decimal places. All incoming orders priced in fractions are  
converted to four decimal places. Buy orders are rounded down; sell orders are rounded  
up. Orders may also be rounded to two decimal places for display purposes.

With respect to redundancy and recovery, the system of invention is designed to  
10 be fully redundant. In this case redundancy refers to an architecture that provides for a  
second process machine or means in the unlikely event that problems were to occur in a  
primary processing component.

Recovery refers to the fact the system of invention uses a complex schema to  
15 ensure that in the event of a problem, it will quickly be able to re-start message  
processing without losing a bit of information. In order to facilitate such recoverability,  
all incoming messages are recorded. Messages are also recorded at other processing  
points within the system. In the event that a problem was to occur, recorded messages for  
a defined period of time will be rebroadcast into the system where it will complete a  
20 pos/dup check to determine if the message had previously been processed.

System processes of the invention will now be described in detail. The system of  
invention includes a number of processes designed to run at defined points and perform a  
specific task or functionality. Such processes are required to run a marketplace.  
25 Examples of these processes are given below:

Inter-state - These processes move the trading system from one trading state to  
another, enacting a new set of rules.

Beginning of Day – This process prepares the trading system to begin a trading day and includes updating the Subscriber and Trading Instrument tables, as well a myriad of other functions.

- 5           End of Day – This process prepares the trading system to end a trading day and includes cancellation of all day orders, updating its trading filed to the CDR, updating Subscribrs of a daily record and a myriad of other functions.

10           The system of invention is further augmented by designed means of facilitating the operations and conducting surveillance therof. The preferred embodiment of both the operations and surveillance element of the System are browser-based screen providing access to real-time trading data and System interaction.

15           The primary functionality of the operations module of the System is to ensure that the System is working efficiently (both hardware and software), Subscribers have access to the system and all other operation issues are addresses.

20           The primary function of the surveillance module of the System is to identify elements of “illegal” trading activity that may occur. Examples of such activity may include “front-running,” collusion, and manipulation to ensure the orderly operation of the marketplace.

25           The hardware of the invention in its preferred embodiment, as previously described in reference to Figures 1 and 2, will now be described in more detail. The hardware and software of the system in its preferred embodiment are designed to provide a system which is secure, fast, stable and scalable. The Computer Systems preferably comprise two logical networks, the Trading Network and the Administrative Network. The two systems are interconnected but operate logically independent of one another. The Administrative Network is primarily Intel based, consisting of Microsoft NT Servers,

Laser Printers, Laptops, Workstations and Thin Clients. This network also contains the necessary connectivity hardware such as: Category 5e cabling, Ethernet Switches, Patch Panels, and Modems. All equipment for this network is housed in locked cabinets in a secure room.

5

The Trading Network is the public portion of the computer infrastructure. The Trading Network houses the actual WEB interface to and from the trading system as well as the application and database servers. All servers and data storage areas utilize FireWall Security (CheckPoint FireWall 1) and are configured totally redundant. The  
10 platforms utilize both RAS and High Availability features. All equipment for this network is housed in locked cabinets in a secure room.

The Servers in the Trading Network are preferably SUN Microsystems servers. The WEB Servers may be parallel Enterprise 250's while the application/database server  
15 is made up of two Enterprise 4500's configured in a cluster. Such clusters have been certified by SUN Microsystems. All disk storage utilizes Raid Level 1, in addition to full disk hardware redundancy.

The Trading Network preferably utilizes some additional hardware in addition to  
20 that of the Administrative Network. The network servers utilize switched, full-duplex 100MB inter-equipment connections. All access to and from the equipment, external and internal, is via redundant Checkpoint Fire Wall 1 firewalls. The Firewalls allow for load balancing to the WEB servers as well as port security. All servers' disk storage is backed up nightly to DLT tape libraries. A 5-week rotation is established with an offsite storage  
25 rotation.

The Administrative Network portion of the infrastructure is the vehicle that enables the carrying out of daily business functions. This network allows for Scheduling,

Calendaring, Task Management, Email, Group Collaboration, Internet Browsing, Word Processing, Filing, Printing and Faxing.

5 All Servers in the Administrative Network may comprise, e.g., Compaq Proliant 1600r's running Microsoft Windows NT Server 4.0. All Servers are Pentium II 450Mhz single and multiprocessor models. The Administrative Network Servers perform a variety of functions for the DNS. These functions are: Domain Authentication, Domain Backup, Email, Faxing, File and Print Services, Internet Proxy Services, Terminal Server, DHCP Services and Domain Backup Services. All of these Servers can connect directly to the  
10 "core" network Ethernet switch via gigabit Ethernet over fiber optic medium.

The workstations are preferably made up of three types of systems: laptops, thin clients and desktops. The laptops are primarily Dell Inspiron 7000's. The thin clients are the NCD ThinStar 300 model. The desktops are Compaq Desk Pro 500Ms.

15

Both the Administrative Network and Trading Network can share a rack of equipment that is used to provide access to and from the Internet, the Clearing Houses and satellite offices. An additional circuit may be used to connect the CTCI interface to the NASDAQ to comply with the 90 Second Trade reporting rule. The equipment in this  
20 rack is comprised of a fiber optic multiplexor that divides the available bandwidth into usable circuits for various purposes. The fiber into the multiplexor is of OC12 capabilities (655 MB), it is split into a burstable T3 (45 MB) for the WEB Servers, Fraction T1's (1.54MB) for the Clearing Houses and the remote offices, and Voice T1's (48 channels) for the telephone switch. The fiber optic access is a spur directly off of an  
25 MCI Fiber Backbone loop (SONET RING).

The interface for the Interactive Order Book of the invention will now be described in detail. In this respect, the invention provides a system and method for aggregating, manipulating and displaying order data. In particular, the invention

provides a novel process by which retail investors or other users view qualifying offers to buy and sell securities in an electronic format. The system and method of the present embodiment preferably operates in conjunction with the trading system described above and preferably provides access to an interactive order book via the Internet or the GUI  
5 such as that described above. However, it will be understood by those skilled in the art that the interactive order book as described below can be used with other securities trading systems and can use networks other than the Internet without departing from the spirit and scope of the invention.

10 The process provides for filtering of internal customer order data and selection of qualifying data for placement on a display mechanism (order book). Order data may include the following elements (in any order), ticker symbol (or other identifier), price (optional), size (quantity), time and date stamp, indication of either buy or sell, any limitations placed thereon and a unique order identifier. Upon submission, the order data  
15 is combined with data regarding the identity of the entering party and other related underlying data (such as account information) to create a unique data set. The process evaluates all entered elements and displays identified qualifying data items.

Data which qualifies for inclusion in the interactive order book display  
20 specifically includes "open" orders, which comprise both priced and unpriced orders (that have yet to receive execution against a contra order or routing to an alternative destination).

The system and method of the invention in accordance with the present  
25 embodiment provides investors with a means to view order data in a real-time, intuitive and openly disseminated manner. The system and method of the invention in accordance with the present embodiment provides Subscribers with a means to view, interact and disseminate order data in a real-time, intuitive and openly disseminated manner. It facilitates a new level of interaction with the user, which is set forth in further detail

below. For years such data has been the sole province of professional traders. Even the language that is used to represent buy and sell orders, "bid" and "ask," respectively, originates from a dealer-style market. The data is made available on a closed network, traditionally available only to brokers. A great deal of effort has been and continues to be made to keep such information from the average investor. Only recently has order data been made available to retail investors, and this is to a select group of "active traders" or wealthy individuals. Such groups are not provided the data in a manner that suits their needs, rather, they are simply provided read-only access to the tools and software of a professional trader.

10

An example of a display mechanism in accordance with the invention is shown in FIG. 3. The display mechanism is preferably color-coded and easily read. It may be designed to combine internal and external order elements. That is, the display preferably provides the investor with both internal order data (order data from the trading system referred-to above) and external order data (data from orders originating in other external sources such as stock exchange systems, or NASDAQ). The invention provides the investor with an improved tool for price discovery (transparency), price improvement and best execution methods.

15

As set forth in detail above, the system of the invention in its preferred embodiment allows Subscriber to enter orders for processing by the system. The underlying elements of certain unexecuted orders will qualify for display in the order book display of the invention. This display can be made available (in different iterations) over the internet and via the GUI. Upon execution, order data is preferably removed from the order book and no longer qualifies for display. The order book may integrate qualifying orders entered into the system with national best price (prices) for both the buy (ask) and sell (bid) data or other external data.

25

Within each book, data is ranked according to the following criteria:

- 1) Price – the price of an order
- 2) Time – the time at which data was entered
- 3) Size – the specified quantity

5           It should be noted that Match orders are unpriced and will be given priority based upon the existing match price (defined below). Depending upon the situation and primary market of the trading element, market orders may also be permitted to “hit” the book. In such instance they will be given priority based upon a means to be determined by the system Administrator. Such a means shall include external best, internal best, last  
10 sale or another price as determined by the system Administrator.

The display mechanism can take several forms as depicted in FIGS 3-8. The display mechanism is security (or product or service) specific and may contain the following elements:

15

- Company Name – name of the company issuing the trading element (or manufacturing, distributing the trading element)
- Symbol – Unique identifier of the element about which data is being collected and displayed
- 20 • Price – Price \$ at which trading will occur
- Size – quantity that one wishes to buy or sell
- Limitation Identifier – symbol alerting user that some (specified or unspecified) limitation was been issued in connection therewith
- National Best Buy (Ask or Offer) – the best (least expensive) widely disseminated  
25 price at which to buy the trading item.
- National Best Sell (Bid) – the best (most expensive) widely disseminated price at which to sell the trading item

- Match price – the mid point of the bid and ask price as determined by the arithmetic median of the National Best Buy and National Best Sell Prices. Note this can also be calculated by the arithmetic mean.
- Unique Identifier – the unique identifier is one that is either order or account specific and will allow the user to track their order throughout the system.

The display mechanism is preferably delineated into two sides, the buy side (Bid) and the sell side (Ask), with the sell side located on the right and the buy side located on the left. FIGS. 3 and 4 illustrate several alternative general formats for the display. In FIG. 3, data from qualifying orders are displayed with size and price shown on the buy side and price and size shown on the sell side. Additional data elements, such as a time associated with each displayed order or an identifier, can be included. Further, as illustrated in FIGS. 3 and 4, data rows on the buy side are preferably ranked in descending order according to 1) price, 2) time, 3) size. As illustrated in FIGS. 3 and 4, data rows on the sell side are ranked in ascending order according to 1) price, 2) time, 3) size.

National (external) buy and sell prices can be included in the display in a number of ways. National best prices can be assigned a unique identifier such as a color or number. In FIGS. 3-8, national best prices could be identified by being displayed in red, but it will be understood that other colors and means for identification of national best prices can be used without departing from the spirit and scope of the invention.

As illustrated in FIGS. 3-8, national best prices may be included in a separate designated row in the order book. National best prices may be included (just as any other order would be) in the book. In this manner they are simply given priority, as any other order would be according to price, time, size. Multiple national prices (widely disseminated) may be included in their own display mechanism next to the system display mechanism

A further feature of the invention is the interactivity that the user is afforded though presentation on the internet. The system of the invention can allow trading participants, through either a sponsoring broker or designated broker participants, to enter  
5 orders directly to the system. Participants may track their order if it is posted to the display mechanism. Participants may track their order via a unique color and/or identifier. For example, the color green may be used to identify a trading participant's own order and the color yellow may be used to identify Match orders.

10 In addition to entering and tracking their orders, trading participants can also amend or delete their orders prior to execution. Any changes will be immediately reflected in the display mechanism, except that there may be a slight delay incorporated in order to preserve order fulfillment integrity if regulatory rules so require. Trading participants can also identify contra orders that they would like to trade against, submit  
15 the order (data), and watch as the identified order is adjusted or removed from the display mechanism.

It should be noted that cloaking may be used in connection with the display of this invention. Cloaking allows the user to choose to cloak a displayed item. A cloaked item  
20 will appear in a form such as [XXXX] that will prohibit anyone viewing the display from knowing the actual value or identifier thereunder. The system administrator will maintain, at its sole discretion, authority over what elements may be cloaked and when they may be cloaked.

25 As a means of increasing interaction with the invention, it may be presented in a way such that an item in the display of each order will be a hyperlink. The hyperlink will bring up an order form. The order form will be pre-filled with the price and size information of the order so chosen. This means will create a new level of interactivity between the invention and the user.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and  
5 scope of the invention.